CANADA

DEPARTMENT OF AGRICULTURE

RESEARCH BRANCH—FOREST BIOLOGY DIVISION

Vol. 15 REPORT Number 3

BI-MONTHLY PROGRESS REPORT

May-June 1959

Published by Authority of the Hon. Douglas S. Harkness, Minister of Agriculture, Ottawa

CURRENT ACTIVITIES

ATLANTIC PROVINCES

Larch Shoot Moth.—In a previous report on the larch shoot moth, *Argyresthia laricella* Kearfott, (Bi-Monthly Progress Report 14(1), 1958), it was noted that this insect had occurred unnoticed in eastern Canada for many years, and that population levels were generally low. Between November 1958 and March 1959, samples were collected in the Atlantic Provinces to obtain estimates of the population levels.

About a thousand dormant shoots of tamarack, *Larix laricina* (DuRoi) K. Koch, were collected at random at each of 27 localities. Samples were taken from 14 widely-separated localities in New Brunswick, from one locality in each of the three counties of Prince Edward Island, from nine locations in Nova Scotia, and from one area south of Corner Brook, Newfoundland. Shoots were taken from trees of all ages growing in the open, from the lower 10 feet of crown, and included a few leaders of trees shorter than this. Preliminary data indicate that populations are lower above the 10-foot level. These shoots were examined by drawing them between the thumb and forefinger, infested shoots breaking easily at the site of damage. Results were tabulated:

—	Shoots	Larvae	Shoots/larva
N. B.	12,334	50	ca. 250
P. E. I.	3,895	26	ca. 150
N. S.	9,023	25	ca. 400
Nfld.	1,359	34	ca. 40

Numbers in the Maritime Provinces are very low; even the higher numbers found near Corner Brook are not high enough to cause concern. In no instance were leaders attacked, nor have infested leaders been observed during studies of the bionomics of this insect.—D. C. Eidt.

ONTARIO

Notes on the American Aspen Beetle.—During 1957 and 1958, the American aspen beetle, *Gonioctena americana* Schæff., was one of many aspen insects reared and under observation in northwestern Ontario. In 1957 it was the most abundant, and in 1958 the second most abundant beetle attacking trembling aspen in the area. Observations and counts indicated that it was most prevalent on young open-growing aspen and on the lower branches of more mature trees. Small pockets of young aspen, up to 10 feet high, were severely defoliated in 1957. No account of the biology of this species has been found in the literature.

Toward the end of May, in both 1957 and 1958, when the basal leaves of aspen were almost fully grown, overwintered adults were found feeding on the leaf edge and copulating on the leaves. About 15 minutes after copulation adults were observed depositing, on the lower surface of the leaf, orange masses of five to thirteen fully-formed embryos each enclosed in a transparent membrane. The membranes ruptured in about ten minutes and the young larvæ began feeding gregariously on the lower surface of the leaf, initially leaving only the upper epidermis, but later perforating the leaf and leaving only the major veins. Later many of the larvae dispersed and became solitary feeders. The larval stage consisted of four instars and lasted about four weeks. Pupation began about the end of June and occurred in the vermiculite in rearing jars; in the field it presumably takes place in the soil or duff. About mid-July the adults emerged and were active on the foliage for a short time and then dropped to the ground where they overwintered. The adults exhibited thanatosis both in spring and summer and have not been seen in flight.

The mode for head capsule width, which appears to follow Dyar's rule, and range in body length for each of the four larval instars are, respectively, first instar 0.5 mm., 1.4—2.3 mm.; second instar 0.7 mm., 2.4—4.0 mm.; third instar 1.0 mm., 5.7—7.5 mm.; fourth instar 1.4 mm., 6.2—10.2 mm. Newly emerged first-instar larvæ are orange-red with a white head capsule; later the larvæ appear black throughout. The most conspicuous characteristic of all larval instars is the blackish tergites on the meso- and metathorax and the first six abdominal segments. The tergites of the seventh and eighth abdominal segments are frequently fused, and sub-dorsally between these segments there is a pair of eversible glands. The unsclerotized areas of the body are creamy white to tan and spiculose in the last two instars. The thoracic legs are the same colour as the body but the tarsus is dark brown and has a single claw. There are in each larval instar six pairs of ocelli and a pair of minute three-segmented antennæ.

The pupa is of the exarate type, not enclosed in a cell, and orange-red. The adults exhibits considerable colour variation from orange-brown to black with variations in size, number, and colour of elytral spots even within a single family.

To date no parasites have been recovered from rearings.—A. H. Rose and E. P. Smereka.

Rhyacionia adana Heinrich, a Pine Tip Moth in Ontario.—Although *R. adana* was described in 1923, its host plants were unknown until 1957 when it was found feeding on red pine, *Pinus resinosa* Ait., Scots pine, *Pinus sylvestris* L., and jack pine, *Pinus banksiana* Lamb. in Ontario.

A study presently underway reveals that this species is common throughout most of southern and central Ontario, where it feeds upon young pines from seedling size to 3 feet in height in nurseries, plantations, and natural stands.

The insect overwinters as a pupa attached to the stem of the tree just beneath the soil surface. The adults emerge in mid-April and lay their eggs on the needles or on the bark of the previous year's shoots. The newly-hatched larvae mine needles and attack the new shoots. The larvae complete their feeding in late June or early July and enter the soil to pupate. They remain in the pupal stage until the following spring.

Destruction of the shoots by this species retards the height growth of the young trees, and in heavy infestations it results in severe deformity and permanent stunting of growth. Injury is largely restricted to shoots from 8 to 14 inches from the ground, and after the trees have reached 3 feet they seem to be entirely free of injury.

This insect has probably been overlooked in the past because the damage has been confused with that of the European pine shoot moth, *Rhyacionia buoliana* Schiff., and at the time the damaged shoots are readily seen, the larvae have already left them to pupate in the soil. The dead shoots are brown and brittle, and they crumble readily under a light presure.—J. L. Martin.

A Method of Determining the Sex of Adult Bark Beetles of the Genus Conophthorus.—Studies of bark beetles of the genus *Conophthorus* in jackpine have made necessary a rapid method of determining sex of the adults. Although Schwarz (Schwarz, E.A. 1895. Description of the pine-cone-inhabiting scolytid. Proc. Ent. Soc. Wash. 3: 143-145.) indicated that the sculpture of the adult head of *Pityophthorus coniperda* Schz. (=*Conophthorus coniperda* (Schz.)) varies according to sex, and Lyons (Lyons, L.A. 1956. Insects affecting seed production in red pine. Part 1. *Conophthorus resinosae* Hopk. Can. Ent. 88: 599-608.) suggested that internal structures visible through the genital opening could be used to determine the sex of adults of *C. resinosae* Hopk., it has been found that the external characteristics of the seventh and eighth abdominal tergites can be readily used to differentiate the sexes.

The seventh and eighth tergites of the female appear as a single plate, apparently as a result of fusion of the two tergites. These tergites are separate and distinct in the male.

The sex of 100 adults of *Conophthorus* spp. from mines in jack pine shoots was determined by the appearance of the seventh and eighth abdominal tergites. Dissections of the genitalia showed that the sex of all the beetles in the sample had been correctly determined. The method also proved to be reliable for sex diagnosis of adults of *C. resinosae* from red pine shoots and *C. coniperda* from white pine cones.

The beetles, which had been preserved in alcohol, were examined at a magnification of 36X. In most cases the elytra had to be lifted from the abdomen in order to expose the tergites. However, live individuals may prove easier to examine, because of the flexibility of the abdomen.—H. Herdy.

PRAIRIE PROVINCES

Photoperiodic Response in Germination of Four Species of Betula.—Long photoperiods or short dark periods are known to promote greatly the germination of unstratified seed of *Betula pubescens* Ehr., and *B. verrucosa* Ehr. at certain temperatures (Vaartaja, O. 1956. Photoperiodic response in germination of seed of certain trees. Can. Jour. Botany, 34: 377-388.) A test of the photoperiodic requirements of seed of four other *Betula* species is reported in the following.

Two hundred seeds of each lot were floated on water in glass jars in each of four cabinets under white fluorescent tubes giving a light intensity of 300 ft. c. By means of running water, the temperature around the jars was maintained first at 15 to 17°C. and later at 25°C. The daily light periods were either 10 hr., or 8+12., or 8+1+1 hr. The corresponding dark periods were 14 hr., 9+5 hr., and 5+5+4 hr., and according to the longest dark period the treatments were called at 14 hr., 9 hr., and 5 hr. nights. By this arrangement all the treatments received the same total amount of light (10 hr. per day,) but were photoperiodically different. There was also a control treatment in continuous darkness (24 hr. night). In darkness during the cool period, germination took place only in seed lot 1 of *B. papyrifera* Marsh. (9%). There was no germination in darkness in *B. mandshurica* var. *japonica* (Miq.) Rehd., *B. glandulosa* Michx., and *B. lenta* L.

Decrease in the length of the dark periods increased the germination of all seeds (Table 1). This indicates that the seed of all these species responds photoperiodically. After 24 days at 15 to 17°C. the germination appeared to be completed. However, when the temperature was raised, there was aditional germination in all seed lots (five examples are shown in Table 1).

The differences between the photoperiodic treatments seemed to decrease or disappear at 25°C. in seed lots 1 and 2. This is as expected on the basis of experiments with *B. verrucosa* and *B. pubescens*. However, in the other seed lots there still remained a definite difference between 5 hr. and 9 hr. treatments.

The eight seed lots of *B. papyrifera* were from widely distant origins between Alaska and Pennsylvania. However, the germination was in no way correlated with the origin. The best (highest germination) seed (lot 1) germinated very well even under 14 hr. night (67% at 14 to 17°C., but poorly (9%) under 12 hr. night. In the next best seeds (lots 2 and 3) the greatest increase in germination was between the 14 hr. and 9 hr. treatments; there was no increase between 9 and 5 hr. treatments. In the rest of the seeds there was a large increase also between the treatments 9 hr. and 5 hr. This suggests that the quality of the seed interacts with the photoperiods, the good seed being less inhibited by lack of light.—O. Vaartaja.

TABLE

GERMINATION OF SEEDS OF *Betula* SPECIES AS AFFECTED BY PHOTOPERIODS

Species and seed lot	Germination percentage under		
	14 hr. night	9 hr. night	5 hr. night
I. After 24 days at 15 to 17° C.			
B. papyrifera 1	37	58	67
2	0	23	16
3	0.3	15	11
4	0.7	5	16
5	0	4	9
6	0	2	3
7	0	2	3
8	0	0	2
B. m. var. *japonica*	0	0.5	6
B. glandulosa	0	1	1
B. lenta	0	0	0
II. After additional 11 days at 25°C.			
B. papyrifera 1	66	65	72
8	1	4	6
B. m. var. *japonica*	6	12	11
B. glandulosa	0	3	3
B. lenta	2	3	7

A Localized Outbreak of the Cottony Maple Scale (Pulvinaria innumerabilis (Rathv.)) in Manitoba.—In early July of 1958 the Laboratory received many phone calls on the abundance of this scale in Greater Winnipeg. Surveys showed extremely high populations of adult scale, especially in sections of St. Boniface and St. Vital. The cottony sacs produced by mature females were so abundant that the under parts of the smaller branches were completely covered, appearing white at a distance. This condition was associated with wilting of foliage caused by nymphal feeding and a secretion of "honey-dew", which supported a sooty fungus. Manitoba maple was the only species severely attacked, although several other tree species are reported to be commonly attacked in other parts of North America. Except for wilting of the foliage in August, no striking damage to affected trees was evident in 1958.

Laboratory records were examined to learn something about the history of this species in Manitoba and Saskatchewan, and it was found that the scale had not been reported in this region since the inception of the Forest Insect Survey in 1938. In some parts of the Continent the scale seldom occurs on the same trees for two successive years because of the numerous predators and parasites that attack it. Inspections were therefore carried out in late May of 1959 to see if infestations will recur. Counts of living and dead female scales were made on sample units of the outer four inches of 1958 and 1957 shoots. The numbers were highest on the 1958 shoots, with living scales averaging about 30 per sample (Table 1) for 1- and 2-year old wood. Winter survival varied greatly, ranging from about 17 to 59 per cent. Although additional mortality may occur before the period of oviposition in June, there is every indication that adult numbers will be high for the second consecutive year even on the same trees.—R. M. Prentice and W. A Reeks.

TABLE I

NUMBERS AND SURVIVAL OF COTTONY MAPLE SCALE ON FOURTEEN 4-INCH SAMPLE TWIGS FROM THREE LOCATIONS IN THE GREATER WINNIPEG AREA, MAY 25, 1958

Location	No. of scales per sample		Percentage Living
	Average	Range	
1	41	13–73	18
2	33	22–51	17
3	16	0–54	59
Average	30		28

ROCKY MOUNTAIN REGION

Parasites of Petrova metallica Busck.—Two parasite species of *Petrova metallica* Busck were reared in 1956 (Bi-Mon. Progr. Rept. 13(4), 1957):

Hyssopus benefactor Cwfd.
Phrynofrontina sp.

Additional rearings in 1958 yielded at least five more parasite species. These were identified by the Systematics Division, Ottawa, as follows:

Amblymerus sp.
Calliephialtes comstockii (Cr.)
Campoplex sp, near *conocola* (Roh.)
Pimplopterus sp.
Scambus n. sp.

A sixth parasite was identified as *Hyssopus* sp. in 1958 but it is not known whether it is the same as that found in 1956.—R. W. Stark.

Blue Stain Fungi Associated with the Mountain Pine Beetle.— Blue-stain fungi are usually introduced into a green tree at the time of attack by adults of the mountain pine beetle. It has been generally thought that these fungi aid in the establishment of the beetles by reducing resin flow, although the mode of this reduction is not known. Preliminary studies were made to investigate this relationship by making slides of blue-stained wood associated with bark beetle galleries to study the distribution of mycelium in the wood cells of lodgepole pine.

Both tangential and transverse sections were made, but it was difficult to obtain sections with the horizontal resin canals intact. In those rays which contained mycelium, the walls of the cells surrounding the resin ducts seemed to be weakened and collapsed during sectioning. To prevent this, the blocks of wood were impregnated with a water-mounting medium (C. T. Gun Ltd., London, Eng., Cat. No. 953) and allowed to dry. This held the walls in place during sectioning. Sections 20 - 30 microns thick were cut from the blocks using a sliding microtome with glycerin as the softening agent and lubricant. The sections were rinsed in water to remove the mounting medium and then were stained with picro-aniline blue, run through an alcohol-xylol series, and mounted in balsam.

Mycelia are concentrated in the uniseriate and fusiform rays, the latter containing the horizontal resin canals. The hyphae penetrate the ray parenchyma cells presumably utilizing the cell contents and food stored there. These cells are gradually destroyed and collapse in the advanced stages. The epithelial cells which secrete the resin do not contain more than an occasional hypha. However, soon after the surrounding parenchyma cells are penetrated, the epithelial cells collapse. The lumen of the resin duct is occasionally penetrated by hyphae but not in sufficient quantity to block it. The blue-stain fungi probably reduce resin production through their effect on the parenchyma cells which conduct the food from the phloem into the sapwood.

These fungi have also been associated with the blockage of water movement up the tree. As the amount of mycelium in the vertical tracheids is negligible the restriction of water conduction is not due to a simple mechanical blockage. The reason may lie in the destruction of the ray parenchyma as the movement of water in the wood is, at least partly, controlled by these cells. (The Structure of Wood, F. W. Jane, 1956 p. 53).—R. F. Shepherd and J. A. Watson.

BRITISH COLUMBIA

Individual Differences in Estimating Defoliation.— The problem of estimating the percentage defoliation caused by insect feeding is one where individual differences play a very large role. This was obvious when ocular estimates were attempted in the spruce budworm infestation in the Lillooet River Valley in 1954. When plots were laid out in the Douglas-fir stands it was decided to have the five men on the party make individual defoliation estimates for comparison.

Ocular defoliation estimates were made on the amount of current year's foliage lost, and on the accumulated defoliation. It was assumed that 20 per cent of the total foliage on Douglas-fir trees was new growth, and another 20 per cent of the total foliage was one year old. Thus if a tree lost all new foliage and half of last year's foliage the loss of new foliage was 100 per cent, and the total defoliation was 30 per cent. Current defoliation was estimated to the nearest 10 per cent and total defoliation as accurately as possible. All men made individual estimates on several trees; the estimates were compared, and then the trees cut and examined closely. After several practice runs the estimates were considered in sufficient agreement for plot work.

Estimates on the percentage of current foliage lost are shown in Table 1, and estimates on total defoliation in Table 2. The plot average was considered to be the average of all individual estimates.

No individual estimates agreed with the plot averages all the time, nor was this expected. What was hoped for was consistency in estimating, i.e., either always above or below, or close to the average. Individual B was consistently below average, the remainder fluctuated above or below the average.

The purpose of ocular defoliation estimates is to obtain, with a fair degree of accuracy, a picture of stand condition, which is combined with egg mass counts for predicting population trend and expected damage the following year. In some instances it is considered accurate enough to estimate defoliation in broad classes such as light, medium, or heavy. Therefore, it was considered that estimates within 10 per cent of the mean were as accurate as could be hoped for. It should be noted that all the individual averages were within 10 per cent of the plot averages. However, as estimates were attempted within 10 per cent of the mean on individual trees there should be compensating differences which would theoretically make the individual averages close to the plot averages, possibly as close as ± 5 per cent.

Six out of the 18, or one-third of the individual averages for current defoliation exceeded the plot averages by more than ± 5 per cent (Table 1). Estimates on total defoliation were much closer, only 2 out of 18, or one-ninth were outside the 5 per cent limit.

While the results of these comparisons were not entirely satisfactory they did lead to several conclusions which were used in future work. It is always advisable to have several practice runs before defoliation estimates are attempted in plot work. At least two and sometimes three men have been used in estimating defoliation in these plots, and the individual estimates grouped to obtain a plot average. As indicated by the tables the higher the degree of defoliation the greater the variation in the individual estimates tend to become. On the whole ocular defoliation estimates are considered satisfactory enough for assessing stand condition.—G. T. Silver.

TABLE I

ESTIMATES OF SPRUCE BUDWORM DEFOLIATION OF CURRENT FOLIAGE OF DOUGLAS-FIR TREES BY INDIVIDUAL OPERATORS. EACH PLOT CONTAINED 20 TREES. PEMBERTON, B. C.

Operator	Percentage defoliation by plots			
	4	5	6	7
A	—	93	75	45
B	57	78	62	43
C	—	87	69	47
D	53	84	59	48
E	67	80	62	50
Average	59	84	66	47

TABLE II

ESTIMATES OF TOTAL DEFOLIATION BY SPRUCE BUDWORM OF DOUGLAS-FIR TREES BY INDIVIDUAL OPERATORS. EACH PLOT CONTAINED 20 TREES. PEMBERTON, B. C.

Operator	Percentage defoliation by plots			
	4	5	6	7
A	—	24	19	12
B	24	28	21	15
C	—	27	20	14
D	29	40	27	20
E	23	31	27	17
Average	25	30	22	15

Autumn-winter Mortality in the Ambrosia Beetle.— Adults of the ambrosia beetle, *Trypodendron lineatum* (Oliv.) overwinter in the forest litter (duff) which they enter by the end of July. Since spring attack flights usually occur in April or May the beetles spend from eight to nine months a year in litter, in an inactive condition. It is important in considering their biology to know something of the mortality during this stage of life. This report describes an attempt to secure information on this point.

In autumn 1957, within the timber margin surrounding a recently logged area near Cowichan Lake, Vancouver Island, collections of litter from around tree bases averaged about 30 *Trypodendron* per handful. With such a high population available for study it seemed worth while, the following spring, to examine carefully samples of litter in order to compare the number of surviving beetles with those which had died or been subject to predation as judged by remains of bodies or isolated parts.

Single handfuls of litter were collected in April, 1958, before any spring flights of this species and stored in plastic bags at 1-4°C. until they were examined, within a month, for live beetles. The litter was then oven-dried and stored until time was available for a very careful search through it for bodies or parts such as legs or elytra. The results of this study are summarized in Tables I and II.

Two sets of some of the figures are given because a few completely intact beetles were found in the dried samples and possibly were alive but had been missed at the first examination. In determining the maximum percentage mortality which may have occurred such beetles were considered as resulting from autumn or winter death; in calculating minimum mortality which might have taken place during the period in litter they were considered as survivors. The frequency distributions are based on figures for maximum percentage mortality.

To test search efficiency, bodies and parts representing 45 beetles were mixed in various amounts in eight beetle-free samples of duff. Recovered parts accounted for 41 beetles (93 per cent). The time during which dead beetles or their body parts remain intact in litter is not known.

Although the samples had been collected from litter of similar appearance and distance within the timber margins it can be seen that there is much variability in the number of beetles in them. This emphasizes the need for more information on factors involved in selection of litter within a given location by the beetles.

About 58 per cent of the mortality was indicated by presence of single elytra or other small body fragments and might be assumed to result from some sort of arthropod predation. The rest of the mortality is due presumably to the action of other biological factors or of physical factors. This approach does not give information on any loss by predators which remove or consume beetles entirely. The data furnished by this study do give, however, a definite impression that during the rather mild winter of 1957-58 and in this particular location on Vancouver Island there was relatively little mortality in the over-wintering population of *Trypodendron*.—J. A. Chapman and R. Neitsch.

TABLE I

SUMMARY OF LITTER SAMPLE DATA ON LIVING AND DEAD BEETLES IN SPRING

Number of samples examined	72
Mean number surviving beetles	33.9 (33.3)*
Mean number dead beetles	2.31 (1.72)*
Mean autumn-winter mortality	6.91% (5.07%)*

* See text.

TABLE II

FREQUENCY DISTRIBUTIONS OF LIVING AND DEAD BEETLES IN 72 SAMPLES OF LITTER

Living	No. samples	Dead	No. samples
0- 15	19	0	9
15- 30	17	1	16
30- 45	19	2	25
45- 60	8	3	6
60- 75	6	4	6
75- 90	2	5	5
90-105	0	6	3
105-120	1	7	1
		8	1

RECENT PUBLICATIONS

Angus, T. A. Potential usefulness of vinyl latices as stickers. Can. Ent. 91: 254-255. 1959.

Atkins, M. D. A study of the flight of the Douglas-fir beetle, *Dendroctonus pseudotsugae* Hopk. I. Flight preparation and response. Can. Ent. 91: 283-291. 1959.

Basham, J. T. Studies in forest pathology. XX. Investigations of the pathological deterioration in killed balsam fir. Can. J. Bot. 37: 291-326. 1959.

Bloomberg, W. J. Root formation of black cottonwood cuttings in relation to region of parent shoot. For. Chron. 35: 13-17. 1959.

Buckner, C. H. The assessment of larch sawfly cocoon predation by small mammals. Can. Ent. 91: 275-282. 1959.

Etheridge, D. E. A non-destructive method of estimating moisture in wood. Can. J. Bot. 37: 491-492. 1959.

Holling,, C. S. The components of predation as revealed by a study of small-mammal predation of the European pine sawfly. Can. Ent 91: 293-320. 1959

Martineau, R. La tordeuse des bourgeons de l'épinette (*Choristoneura fumiferana* (Clem.)) dans la Province de Québec—1939-58. Ann. Rept. Corp. Ing. For. Prov. Qué. 1958.

Prebble, M. L. Development of forest insect research and control in Canada. J. For. 57: 255-259. 1959

Smirnoff, W. A. Predators of *Neodiprion swainei* Midd. Larval vectors of virus diseases. Can. Ent. 91: 246-248 1959.

Sullivan, C. R. The effect of light and temperature on the behaviour of adults of the white pine weevil, *Pissodes strobi* Peck. Can. Ent. 91: 213-232 1959.

Thompson, H. M. A microsporidian infection in the jackpine budworm, *Choristoneura pinus* Free. Can. J. Zool. 37: 117-120. 1959.

Webb, F. E. Aerial chemical control of forest insects with reference to the Canadian situation. Can. Fish Culturist 24: 3-16 1959. (Dept. Fisheries, Ottawa, Canada).

The Queen's Printer and Controller of Stationery, Ottawa, 1959

O. H. M. S.

RESEARCH BRANCH
DEPARTMENT OF AGRICULTURE
OTTAWA